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there has been some error of observation. It must be said, however, that the conclusions of Mr. Dawson have been confirmed by two other competent members of the survey.—*E. D. Cope.*

The Cross-Timbers of Texas.—The paper recently read before the Washington Philosophical Society on "The Cross-Timbers of Texas," by Mr. Robert T. Hill, who is a native of that State, and now connected with the United States Geological Survey, gives some interesting data about that hitherto little studied region. The article demonstrated that these two belts of anomalous timber, instead of representing quaternary or tertiary basins, are merely the detritus of outcrops of arenaceous strata, those of the eastern member being probably of the age of Dakota sandstone, and the western of a sandy group at the base of the entire cretaceous series, part of which are of undetermined Mesozoic, and are given the name of "Dinosaur Sands" by Mr. Hill, while part of them are of undoubted Carboniferous age. He furthermore shows that the topography of the entire central region is the result of extensive denudation, whereby the members of the geologic series, from the marine tertiary to the Carboniferous coal-measures, are successively exposed along the line of the Texas Pacific Railroad, from Elmo to Millsap. The most interesting feature of Mr. Hill's paper, however, is that he demonstrates the existence of a marine group of the Cretaceous in Texas lower than any heretofore recognized in America, and completely clears up, by methods of stratagraphic palæontology, the vagueness that has hitherto accompanied our knowledge of that region. The palæontological results of the work are also very interesting, and will be studied and presented by Dr. C. A. White.

MINERALOGY AND PETROGRAPHY.[1]

Rosenbusch's "Massige Gesteine."—It is rarely that the revision of a standard work in any branch of science is followed with so much interest as has been the case with Professor Rosenbusch's "Mikroskopische Physiographie der Mineralien und Gesteine," the first part of the second volume[2] of which has recently been issued. When the first edition of this classical work appeared (1877) the study of rocks by means of the microscope had but just begun to take its place as an independent science, requiring new methods of investigation, new apparatus for these investigations, and new modes of reasoning by which the truths revealed by them could be made use of in the elucidation of many obscure problems in the broader science of geology. It is not surprising, then, that as petrography increased its store of

[1] Edited by Dr. W. S. Bayley, Madison, Wisconsin.

[2] Massige Gesteine, I. Abt., Stuttgart, 1886. E. Schweizer bart'sche Verlagshandlung (E. Koch).

observed facts, and the number of minds devoting themselves to the application of these facts to the study of the rocks themselves and to their origin became greater, new fields were explored and new facts were observed, which seemed to contradict many of the deductions obtained by the earlier investigators, and rendered a revision of their views necessary. This is especially true in regard to the classification of the massive rocks, the separation of these rock-masses into families,—into groups, all the members of which are characterized by certain general properties which mark them as belonging to the same group, and distinguish them from the members of other groups. Until we know the history of every rock on our globe and can trace it back to its origin through all the changes which it has undergone since its first existence as a distinct portion of the original molten magma, all attempts at a perfect classification of these bodies must be futile, and the classification itself must be an artificial one. As we can never expect to know everything relating to even a single rock type, so we can never expect to possess a perfect classification of rocks. The differences in structure produced during the solidification of molten masses by slight differences in the conditions of temperature and pressure under which they cool are so great, and our knowledge of the effects of these differences is so limited, that we must be content with that classification which best conforms with the facts known and incorporates them in a consistent whole. In no *natural* science can we hope for more than this, and least of all can we hope for it in petrography, the materials of which are the embodiments of the action of largely unknown conditions on substances of whose original nature little can be *positively* known. It is safe to affirm that no classification of rocks ever proposed has met with such general acceptation as that of Professor Rosenbusch's as developed in the first edition of his "Massige Gesteine." That this, however, did not fully meet the requirements of the rapidly-growing science has been acknowledged for some years past. That classification was based upon the fundamental notion that rocks erupted before the Tertiary period in geological time, in consequence of certain conditions then prevailing, possessed structural and mineralogical characteristics which distinguished them from those of more recent age. This, then, was taken as the ground upon which to separate all massive rocks into two great divisions,—the pre-Tertiary and the recent rocks. These were again subdivided according to their structure into granular, porphyritic, and glassy rocks; and finally the members of the subdivisions were classified by groups in accordance with their mineralogical composition. Recent investigations, especially those of Italian and American workers, have shown that structure is dependent not upon the age at which rock-masses were formed, but rather upon the geological conditions under which they were produced. A mass of molten material which flowed out upon a land surface and there cooled, no matter in what geological period, always possesses characteristics which distinguish it from a mass of the same chemical composition which cooled slowly at some distance below the surface. It is probable that rocks of the latter class have been formed throughout all time since the beginning of the Laurentian, and may be in process of formation at present, but at such depths that we can never hope to see them. That most of the plutonic rocks with which we have to deal were really formed early in the earth's history, is due merely to the fact that that portion of the earth's crust in which they are found has been eroded to such an extent as to lay bare its innermost depths.

In the new volume under consideration, Rosenbusch characterizes these deeply-formed rocks as possessing, I., each of their constituents in but one generation, and, II., so developed that the different individuals have mutually interfered with each other's growth, thus giving rise to the granular (körnige) structure. When none of the constituents possess crystal outlines, the structure is called *hypidiomorphic;* when certain of the constituents are so developed, the structure is known as *panidiomorphic.* Rocks which were produced at great depths, and consequently possess this granular structure, are designated as intrusive or plutonic (Tiefengesteine).

The intrusive rocks are subdivided in accordance with their chemical and mineralogical composition into granites, syenites, eleolite syenites, diorites, gabbros and norites, diabases, theralites, and peridotites. All these are characterized by the possession of the *hypidiomorphic* structure, in which by far the larger part of the constituents are *allotriomorphic* (possess a form due to external causes and not to the action of intermolecular forces,—*i.e.*, are not developed with crystal outlines). When any of the intrusive rocks occur as sheets between older rocks (are "Lagerförmig") they assume some of the peculiarities of rocks which cooled at or near the surface. In other words, some of their constituents become *idiomorphic* (possess crystal outlines), and the rock tends to the *panidiomorphic* structure, such as many of the diabases.

On glancing over the list of the names of intrusive rocks, it will be noticed that in it are included, with the single exception of teschnite, all those formerly described as pre-Tertiary with a granular structure. In the place of teschnite we find the new type theralite.

The abolition of the old type teschnite is due particularly to the work of Rohrbach, who, in 1885, after a thorough examination of specimens from every locality within his reach, concluded that in not a single instance could any trace of nepheline be detected. He referred most of the teschnites to the diabase group. This disposition Rosenbusch accepts as the correct one for many of the rocks heretofore denominated teschnites, and among them that from Teschen, Moravia, named by Hohenegger teschnite, in which Zirkel, in 1868, and Tschermak, in 1869, thought they had found nepheline. Since, therefore, the original teschnite is probably only a variety of diabase, it was thought best to drop the name as descriptive of intrusive nepheline-plagioclase rocks, and to substitute for it the name theralite (*θηρᾷν*—seek diligently).

This name is intended to cover all intrusive rocks containing nepheline and plagioclase as prime constituents. That such rocks occur has not yet been positively proved, although the recent work of Wolff in Montana and the earlier work of Hawes and of Harrington in the neighborhood of Montreal, Canada, render their existence probable.

The gabbros and the norites have been included together in one family, the former comprehending those plagioclase rocks in which a monoclinic augite (of a composition approaching that of diallage) occurs as the predominant bisilicate constituent, and the latter those in which this augitic constituent is orthorhombic. Every gradation between the typical gabbro and the typical norite is recognized as possible.

The diabases are regarded as occupying a peculiar position among the intrusive rocks. Their occurrence as sheets between clastic rocks allows them sometimes to assume certain of the characteristics of thin magmas which cooled at the surface, such as the possession of amygdaloidal upper surfaces, the association with them of tufas, etc. The greater mass of diabase, however, Rosenbusch describes as intrusive (in sheets or dykes), hypidiomorphic granular rocks, generally of an early geological age, though occasionally of a very recent one, which possess as essential constituents a plagioclase and augite. In his earlier description of this rock chlorite also was considered as essential. This mineral is now regarded as merely secondary, the last product in the alteration of the augite. In this connection occasion is taken to remark that uralitizatine is not a paramorphism of hornblende after augite, but that the change is probably due to loss of calcium,—the hornblende is an apomorph. The frequent association of epidote with chlorite would seem to confirm this view.

The new name Harzburgite is proposed for the hypersthene and bronzite peridotites, which Wadsworth in his "Lithological Studies" calls Saxonite.[1] Wadsworth's name is based on a description of Dathe's, which this writer himself acknowledges to be erroneous in some of its essential particulars.

The second great class is that of the dyke rocks. These are not as well characterized as the intrusive class. The conditions under which they solidified have varied to such an extent, in consequence of differences in the thickness of the dyke, in the depths at which given portions crystallized, in the degree of conductivity of the rocks penetrated, etc., that all types of structure are found among them. As might be expected, this class is much less well defined than that of the intrusive rocks considered above, or that of the effusive rocks to be examined later. In it are included only those rocks which can neither be regarded as intrusive nor yet as effusive. They are divided according to structure into three distinct types,—I., the granitic; II., the grano-porphyritic; and, III., the lamprophyric. They all tend to the development of one or the other of their constituents in porphyritic crystals; in other words, they are all panidiomorphic.

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[1] American Naturalist, Notes, May, 1885, p. 499.

The granitic class includes only aplite and beresite.

The structure of the grano-porphyritic type is defined by the name. They are porphyries in the sense that they contain certain of their ingredients in two generations, but differ from them in the possession of a holocrystalline ground-mass. Among the grano-porphyritic class are placed granite-porphyry, syenite-porphyry, eleolite-syenite-porphyry, diorite-porphyrite, and quartz-diorite-porphyrite. It will be seen that this class embraces most of those pre-Tertiary porphyritic rocks that are not true porphyries.

The lamprophyres are distinguished from the grano-porphyritic group by the prevalence of bisilicates and the subordination of the feldspathic constituents. They consist of a fine-grained to very compact (dicht) ground-mass, in which porphyritic crystals of biotite, augite, or hornblende are scattered. They all weather very readily, and, as a consequence, contain a great deal of calcite, so that in many cases before their structure can be studied it is necessary to etch their thin sections with a dilute acid.

The lamprophyres are subdivided into the syenitic and the dioritic varieties. The syenitic varieties include minette, characterized by the predominance of biotite, and vogesite, in which the place of the biotite is taken by hornblende or augite. The dioritic varieties embrace kersantite and camptonite. The latter name is applied to the porphyritic diorites described by Hawes[1] from the neighborhood of Campton, N. H. They contain porphyritic brown hornblende and lath-shaped plagioclase crystals in a ground-mass composed essentially of green augite, apatite, and a glassy base in which amygdules occasionally exist.

The third and last great class of rocks is that of the effusives (Ergussgesteine). It embraces those which were poured out upon the surface and then solidified. They are found in sheets and in volcanic streams (Decke and Ströme). There seems to be no reason why there should not be a corresponding effusive rock for every intrusive one, if difference of structure is due merely to difference in conditions of cooling. As a fact, however, it is found that the effusive rocks are always more acid than their corresponding intrusive equivalents. This is accounted for by Rosenbusch on the assumption that during the gradual rise of the magma in the cracks through which it reached the surface enough time was consumed to allow of its separation into strata, the heavier, more basic portions accumulating towards the bottom, and the lighter portion floating on the top.

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[1] Mineralogy and Lithology of New Hampshire, 1878, p. 160.

The characteristic structure of the effusive rocks is the porphyritic. The porphyritic crystals are supposed to have been developed at the period during which the rock was ascending to the surface. After it reached the surface another more rapid crystallization set in, and the result is a glassy or finely-granular ground-mass.

The effusive rocks are divided into two classes, according to age. This is the only remnant left of the old classification into pre-Tertiary and recent rocks. Here certain characteristics are noted in those rocks erupted at an early geological period, which distinguish them from the rocks of later eruptions,—*e.g.*, the ground-mass, of the older rocks, is more lithoidal in character than that of the younger ones, the appearance of their porphyritic feldspathic constituents is different, etc. Whether these differences are of primary or secondary origin is still a matter of doubt. The pretertiary effusive rocks are known as palæo-volcanic, the younger ones as neo-volcanic.

The palæo-volcanic rocks include the quartz-porphyries, quartz-free-porphyries, porphyrites, augite-porphyrites and melaphyres, and the pikrite-porphyrites.

The full discussion of the different varieties of the palæo-volcanic rocks and the entire discussion of the younger class are left to the second part of the book, which is promised to appear in a few months. It is of course impossible to give any adequate conception of the amount of new material incorporated in this volume, or even to mention all the important results reached in its consideration. Perhaps the most important of all the advances have been in the direction of what is now known as dynamical metamorphism, by the action of which a massive rock is made to assume a schistose structure. This mode of alteration is treated in some detail.

It is needless to say that the very latest publications have all been critically examined and their teachings made use of in developing the new system of classification. It is a matter worthy of note that quite a large proportion of the most instructive papers bearing on this subject have been presented by Americans.

Instructors in petrography, and all those to whom a ready knowledge of German is denied, will be glad to learn that a translation of both the first and second volumes of the "Mikroskopische Physiographie" is contemplated by Mr. J. P. Iddings, of Washington. It is proposed to omit those parts which are not essential to the production of a good text-book, and to incorporate the remaining portions in one volume. As the labor involved in translating the work is very great, it may be some time before the English version is given to the public.

BOTANY.[1]

A Study of the Growing Parts of the Stem of Pinus strobus. THE WHITE PINE.[2]—Before beginning work on this special part of the subject a cursory examination was made of the tissues in general as compared with that of *Pinus sylvestris*, the so-called Scotch Pine. Roughly speaking, they are the same,—a central pith, a zone of xylem varying in width according to the number of years' growth, the phlœum, outer cortex, and the epidermal system. But by direct comparison the tissue of the White Pine is seen to be more dense than that of its foreign relative,—the cells having a smaller diameter and the resin passages being smaller and less numerous.

In *Pinus sylvestris* there are two rows of resin passages in each year's growth of the xylem, one comparatively near each margin of the zone, while in *Pinus strobus* there is but one row, which lies towards the outer part of the zone. Sometimes an extra passage is found lying deeper in the xylem. On the contrary, in the outer cortical tissue of *Pinus strobus* are two rows of resin passages, the inner row being much larger than the outer one, but both being quite large, while there is but one row found here in *Pinus sylvestris*.

Growing from the epidermis of the bud and young shoot of *Pinus strobus* are many glandular, often capitate, hairs, composed of but two or three somewhat elongated cells, filled with densely granular matter. These appear to be secretory hairs, producing the resin that is found in such abundance in the bud of the White Pine. They were not found in the Scotch Pine.

In the phlœum, in elongated cells which are distributed irregularly throughout this tissue, with the exception that they never occur within a zone of about eight cells from the xylem, occur large numbers of crystals of oxalate of lime. Fig. 1 of plate is a camera drawing of a longitudinal tangential section through the phlœum of a one-year-old stem, showing parts of five of these cells, three of which contain crystals. These crystals do not lie in the cell-wall, but are embedded in a substance which more or less completely fills the cell, offers great resistance to acids, is

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[1] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.

[2] Selected for publication from original work of students in the botanical laboratory of the University of Michigan, 1885–86, and communicated by Professor V. M. Spalding.